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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A question driven socio-hydrological modeling process" *by* M. Garcia et al.

M. Garcia et al.

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Dear Mr. van Emmerik,

Thank you for your very thoughtful and insightful comments. We appreciate the time and effort you put into these. We have prepared some responses below.

1. You raise a good point about the nature of hypotheses. The 2014 paper by Elshafei et al. clearly states both the broad research question and the specific hypothesis being tested. Other modeling studies, to our knowledge, do not explicitly specify the question and hypothesis. We will re-write this to reflect the idea that we are addressing explicitly stated research questions and hypotheses while many other studies address questions and hypotheses implicitly within their respective model designs.

2. The comment about the wide range of socio-hydrological models is well-taken. We will provide a much more finely tuned review of approaches used in socio-hydrological modeling studies particularly in light of the recently reported reviews you list (Troy et al. 2015; Blair and Buyaert, 2015). So we will expand our discussion of existing socio-hydrological models and the approaches they use to clarify how ours is different and unique. We agree that the WRR debates provide a perfect foundation for this.

3. You are correct to note the importance of the case study vis a vis illustrating the dynamic hypothesis, and we now recognize that it is introduced abruptly. We will add some description to make this transition softer, and to make the purpose of the case study clearer in this sense. We will probably provide a little background on reservoir management and demand change to do this. The question about what makes this hypothesis dynamic is somewhat discussed in the paper, although we will certainly consider making this more explicit. The definition of a dynamic hypothesis we use comes from the system dynamics literature, particularly Sterman, 2000; it is a hypothesis that explains observed behavior in terms of feedback processes and the structure of the system. We treat our hypothesis as dynamic because it explains an observed pattern of per capita demand change over time in terms of a feedback between past system shortage or stress and the adoption of conservation technology and practices. The feedback process specified in the dynamic hypothesis is not expected to change over time; however, as described in the paragraph on the demand change equation (pages 8308-8309), the strength and relevance of this feedback may change over time.

4. Thank you, the background information on Sunshine City could be trimmed, and we will try to make sure the described characteristics are directly relevant. We believe the background on reservoir management and demand change is important as it serves to motivate and support the hypothesis. However, as mentioned in the response to comment 3, some of this information may fit better before the introduction of the hypothesis.

5. Thank you, the error in the Kandasamy reference will be corrected. The Elshafei et al. (2014) and van Emmerik et al. (2014) papers are directly relevant and we will add

these citations.

6. The description of the model equations will be revised to include reference to each symbol and note units. We agree that the reader shouldn't have to deduce what we mean here.

7. A brief description of the non-coupled model is presented on page 8311. However, we agree that a more detailed description is warranted and that comparison to previous modeling efforts would be useful. There is a logic to this comparison, and we will make this logic explicit and clearer.

8. Thank you for this comment. Multiple trials were included to illustrate the impact of both the magnitude and timing of fluctuations in streamflow and to show that observed results hold true across a range of those conditions. However, we do not make this very clear and will improve the justification for this approach. Additionally, we will consider alternate forms of presentation that could make this section more concise and more direct.

9. Thank you, you make a good point on the clarity and focus on the discussion section. We will revise the discussion to focus first on the question driven modeling process. Then we will proceed to discuss impacts of the competing operating strategies as a result of the coupled model and as an outcome of the question driven process.

10. The recommendation that we add some text to explain how this analysis uses socio-hydrology to advance understandings of systems is an excellent recommendation. We will emphasize this point in the revision.

11. The case study is greatly simplified, and this fact will be mentioned at the introduction to the case study.

12. We chose to illustrate the modeling process first on one hypothetical case for simplicity and brevity. Our hope is that we will be able to build on this with future versions. While we are also working on a case-based modeling project, we found

that explaining the full range of context and assumptions of the case along with the modeling process was beyond the scope of a single paper.

13. There is some repetitiveness in the conclusions, and we will clean this up. We will emphasize the novelty of the current work and tone down the discussion of what might be lacking in other studies.

14. As we re-read the conclusions, we agree with the observation that the conclusions do not do a very good job of succinctly stating why this approach is superior for the purpose we develop. We will certainly make sure we provide a stronger statement.

Regards,

Margaret Garcia, Kent Portney and Shafiqul Islam

References

Blair, P., & Buytaert, W. Modelling socio-hydrological systems: a review of concepts, approaches and applications. Hydrol. Earth Syst. Sci. Discuss., 12, 8761–8851. doi:10.5194/hessd-12-8761-2015, 2015

Elshafei, Y., Sivapalan, M., Tonts, M., & Hipsey, M. R.: A prototype framework for models of socio-hydrology: identification of key feedback loops and parameterisation approach. Hydrol. Earth Syst. Sci., 18, 2141–2166. doi:10.5194/hess-18-2141-2014, 2014

Sterman, J. D.: Business dynamics: systems thinking and modeling for a complex world (Vol. 19). Boston: Irwin/McGraw-Hill, 2000

Troy, T. J., Konar, M., Srinivasan, V., & Thompson, S.: Moving sociohydrology forward: a synthesis across studies. Hydrol. Earth Syst. Sci., 19, 3667–3679. doi:10.5194/hess-19-3667-2015, 2015

van Emmerik, T. H. M., Li, Z., Sivapalan, M., Pande, S., Kandasamy, J., Savenije, H. H. G., Chanan, A., and Vigneswaran, S.: Socio-hydrologic modeling to understand and

mediate the competition for water between agriculture development and environmental health: Murrumbidgee River basin, Australia. Hydrol. Earth Syst. Sci., 18, 4239–4259. doi:10.5194/hess-18-4239-2014, 2014

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 8289, 2015.